J/ψ Production and Absorption in High Energy Proton-Nucleus Collisions*

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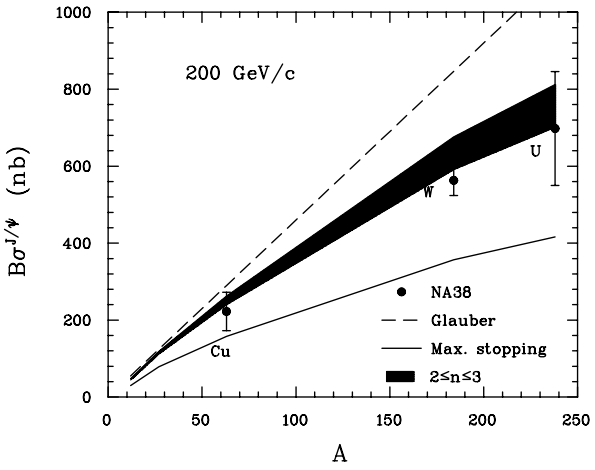
Propagation of a highly relativistic particle through a medium is of interest in several areas of physics. High energy proton-nucleus scattering has been studied for many decades by both the nuclear and particle physics communities. Such studies are particularly relevant for the Relativistic Heavy Ion Collider (RHIC), which will collide beams of gold nuclei at an energy of 100 GeV per nucleon, and for the Large Hadron Collider (LHC), which will collide beams of lead nuclei at 1500 GeV per nucleon.

One of the particularly interesting phenomnena is the production of J/ψ in high energy proton-nucleus. This is a relatively hard process and hence both energy loss of the beam proton and the Landau-Pomeranchuck-Migdal effect has to be taken into account. In previous studies, Glauber analysis without energy loss was used to obtain $\sigma_{\rm abs} = 6-7$ mb. This has formed the basis for many analyses of J/ψ suppression in heavy ion collisions. Any anomalous suppression may be an indication of the formation of quark-gluon plasma, hence the importance of obtaining the most accurate value of $\sigma_{\rm abs}$ possible. This cross section has also been inferred from photoproduction experiments of J/ψ on nuclei from which a value much less than that has been obtained [1]. This has been a puzzle. In this study, we take into account both effects and found that the absorption cross-section doesn't have to be much different from the measured value.

For a basic description of high energy proton-nucleus scattering we prefer to work with hadronic variables rather than partonic ones. We make a straightforward linear extrapolation from proton-proton scattering. This extrapolation, referred to as LEXUS, was detailed and applied to nucleus-nucleus collisions at beam energies of several hundred GeV per nucleon in ref.[2], and to Drell-Yan production in 800 GeV proton-nucleus collisions in ref.[3].

A typical result with the absorption cross-section obtained in the photo-production experiment ($\sigma_{\rm abs} = 3.6$ mb) and pion formation time of 0.5 fm, is shown in the following figure.



The fitted values all lie within one standard deviation of the data points. This is quite a satisfactory representation of the data. It means that J/ψ production in high energy proton-nucleus collisions can be understood in terms of a conventional hadronic analysis when the energy loss of the beam proton, the Landau-Pomeranchuk-Migdal effect, and nuclear absorption of the J/ψ in the final state is taken into account.

[1] R. L. Anderson *et al.*, Phys. Rev. Lett. **38**, 263 (1977); M. D. Sokolov *et. al.*, Phys. Rev. Lett. **57**, 3003 (1986)

[2] S. Jeon and J. Kapusta, Phys. Rev. C **56**, 468 (1997)

[3] C. Gale, S. Jeon and J. Kapusta, preprint hep-ph/9808352

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